

CLAIMS

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. A process for the improved electrorefining of minor actinides and transuranic elements, the process comprising:
 - a) supplying the actinides and transuranic elements in the form of spent nuclear fuel;
 - 5 b) placing the spent fuel in an anode basket;
 - c) contacting an electrolyte containing actinide chlorides with the anode basket and a cathode;
 - d) positioning a porous barrier between the anode basket and cathode so as to form an anolyte compartment and a catholyte compartment; and
 - 10 e) causing the concentrations of uranium ions, minor actinide ions, and transuranic ions in the catholyte compartment to decrease.

2. The process as recited in claim 1 wherein the decrease in uranium ion concentration occurs simultaneously with deposition of actinides on the cathode.

3. The process as recited in claim 1 wherein the barrier is permeable to actinide element ions and transuranic element ions.

4. The process as recited in claim 1 wherein the porous barrier isolates anode reaction products from the cathode.

5. The process as recited in claim 1 wherein the process further comprises the oxidation of metallic uranium and metallic transuranics at the anode.

6. The process as recited in claim 1 wherein the process further comprises the reduction of metallic uranium and metallic transuranics at the cathode.

7. The process as recited in claim 1 wherein the process further comprises an applied voltage between the anode and cathode with a range from of about 0.8 volt (V) to 1.5 V.

8. The process as recited in claim 1 wherein the porous barrier causes the uranium ion concentration in the cathode salt to become lower than the uranium ion concentration in the anode salt.

9. The process as recited in claim 8 wherein an increase in the thickness of the porous barrier lowers further the uranium ion concentration in the catholyte.

10. The process as recited in claim 9 wherein a decrease in the porosity of the porous barrier lowers further the uranium ion concentration in the catholyte.

11. The process as recited in claim 8 wherein the lowering of the uranium ion concentration in the catholyte causes the preferential deposition of minor actinides and transuranics at the cathode.

- 5
12. A device for the improved electrorefining of actinides and transuranic elements from a molten salt electrolyte, the device comprising:
- a) a means for oxidizing the actinides and transuranic elements;
 - b) a means for reducing the oxidized elements; and
 - c) a means for controlling migration of the oxidized elements to the reducing means so as to selectively reduce the actinides.
13. The device as recited in claim 12 wherein the controlling means is a porous barrier made of a material selected from the group consisting of aluminum felt, porous aluminum nitride, porous beryllium oxide BeO.
14. The device as recited in claim 12 wherein the oxidizing means is solid uranium metal.
15. The device as recited in claim 13 wherein the porous barrier separates the oxidizing means from the reducing means.
16. The device as recited in claim 12 wherein the controlling means allows uranium to migrate between an anolyte and a catholyte.
17. The device as recited in claim 16 wherein the controlling means causes uranium ion concentration in the catholyte to be lower than the uranium ion concentration in the anolyte.
18. The device as recited in claim 17 wherein an increase in the thickness of the porous barrier lowers further the uranium ion concentration in the catholyte.
19. The process as recited in claim 17 wherein a decrease in the porosity of the porous barrier lowers further the uranium ion concentration in the catholyte.
20. The device as recited in claim 17 wherein the porous barrier encapsulates the catholyte.